

Food plants and life histories of sawflies of the families Argidae and Tenthredinidae (Hymenoptera) in Costa Rica, a supplement

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Abstract

Food plants and information on life history are presented for six species of Argidae and four species of Tenthredinidae in Costa Rica. The Argidae include cocoons of *Atomacera josefernandezi* Smith, **sp. n.**, found on *Hampea appendiculata* (Donn. Sm.) Standl. (Malvaceae) and likely feeding on its leaves before pupation, and larvae of *Eriglenum tristum* Smith feeding on *Machaerium seemanii* Benth. Ex Seem. (Fabaceae), *Ptenos leucopodus* (Cameron) feeding on *Inga oerstedia* Benth. and *I. vera* Willd. (Fabaceae), *Ptilia peleterii* (Gray) feeding on *Cnestidium rufescens* (Connaraceae), and *Scobina lepida* (Klug) and *S. notaticollis* (Konow) feeding on *Sida rhombifolia* L. (Malvaceae). The Tenthredinidae include larvae of *Dochmioglene crassa* (Cameron) feeding on the fern *Lomariopsis vestita* E. Fourn. (Lomariopsidaceae), *Dochmiogleme* Smith03 feeding on *Blechnum occidentale* L. (Blechnaceae), *Waldheimia laeta* (Cameron) feeding on *Cissus alata* Jacq. (Vitaceae), and *Waldheimia lucianocapellii* Smith, **sp. n.**, feeding on *Davilla nitida* (Vahl) Kubitzki (Dilleniaceae). *Waldheimia lucianocapellii* is described from specimens from both Panama and Costa Rica. *Selandria crassa* Cameron, 1883 is a **comb. n.** in *Dochmioglene*.

Keywords

Symphyla, Area de Conservación Guanacaste, ACG, fern, tropical dry forest, tropical rain forest

Introduction

Two previous papers presented food plants and life history notes on twelve species of Argidae (Smith and Janzen 2003a) and five species of Tenthredinidae and six species of Pergidae (Smith and Janzen 2003b). Since, several other species have been reared during the ongoing caterpillar inventory of Area de Conservación Guanacaste (ACG) in Guanacaste Province in northwestern Costa Rica. Here, we report on six additional species of Argidae and four additional species of Tenthredinidae.

Materials and methods

Acronyms used are: USNM, National Museum of Natural History, Smithsonian Institution, Washington, DC, USA; INBio, Instituto Nacional de Biodiversidad, Santo Domingo de Heredia, Costa Rica; BMNH, The Natural History Museum, London, U.K.

Images 1–15 were obtained using an EntoVision Imaging Suite that included a firewire JVC KY-75 3CCD digital camera mounted to a Leica M16 zoom lens via a Leica z-step microscope stand. Multiple focal planes were merged using Cartograph 5.6.0 (Microvision Instruments, France) software. Images 16–22 are from the ACG website, cited below.

Voucher codes associated with each reared adult are expressed as, for example, “99-SRNP-4547” (year-Santa Rosa National Park-unique rearing number for that year). This code is unique for the event of finding and rearing the caterpillar, irrespective of what it produces. Full details of the voucher records and associated images may be obtained at <http://janzen.sas.upenn.edu> and in Janzen (2000, 2001), Burns and Janzen (2001), and Janzen and Hallwachs (2011). Most adult specimens have been DNA barcoded (see acknowledgments).

The format follows Smith and Janzen (2003a, 2003b).

Results

Argidae

Atomacera josefernandezi Smith, sp. n.

<http://zoobank.org/8FBA5D7B-A71F-42D8-8EC3-FA2401840903>

http://species-id.net/wiki/Atomacera_josefernandezi

Figs 1–3, 12, 16

Description. Female (Figs 1–3). Length, 4.0 mm. Head black, labrum and mandible whitish. Antenna black with first and second antennomeres dark orange. Thorax black with pronotum, tegula, mesoprescutum, and mesonotal lateral lobes red; mesosternum



Figures 1–3. *Atomacera josefernandezi*. **1** Lateral **2** Dorsum of head and thorax **3** Face, front.

dark orange. Legs mostly white; tarsi black, tibiae with apex black and spot of black near base, black more distinct on hind tibia. Abdomen black. Wings darkly infuscated, slightly lighter toward apex; veins and stigma black.

Head smooth and shining, without punctures or other sculpture. Antennal length $1.3\times$ head width. Lower interocular distance about $1.2\times$ eye height. Distances between eye and hind ocellus, between hind ocelli, and between hind ocellus and posterior margin of head as $1.0:1.2:0.5$. Clypeus with shallow central emargination. Interantennal area rounded, without carina. Malar space about $1.3\times$ diameter of front ocellus.

Postocellar area very short, almost non-existent, sloping downward just behind lateral ocelli; without lateral postocellar grooves. Forewing with 4 cubital cells, first cubital crossvein may be weak. Hind basitarsomere $0.9\times$ length of remaining tarsomeres combined. Sheath uniformly slender in dorsal view, straight above and rounded below in lateral view. Lancet (Fig. 12) with serrulae moderately deep, with 1 or 2 anterior and 4–5 posterior subbasal teeth; annuli slightly curved in basal half, straighter in apical half; short hairs on annuli.

Male. Unknown.

Type material. Holotype female, labeled “Voucher: D. H. Janzen & W. Hallwachs, DB: <http://Janzen.sas.upenn.edu>, Area de Conservación Guanacaste, Costa Rica, 11-SRNP-20098,” “legs away for DNA” (USNM). Paratypes: Same data except for voucher numbers, 10-SRNP-22258 (♀), 10-SRNP-22259 (1 ♀), 10-SRNP-22260 (1 ♀), 10-SRNP-22263 (1 ♀), 10-SRNP-22264 (1 ♀), 10-SRNP-22265 (1 ♀), 10-SRNP-22266 (1 ♀), 10-SRNP-22269 (1 ♀), 10-SRNP-22272 (1 ♀), 10-SRNP-22273 (1 ♀), 10-SRNP-22274 (1 ♀), 11-SRNP-20096 (1 ♀), 11-SRNP-20099 (1 ♀), 11-SRNP-20104 (1 ♀), 11-SRNP-20105 (1 ♀), 11-SRNP-20109 (1 ♀), 11-SRNP-20110 (1 ♀) (USNM, INBio).

Etymology. This species is named in honor of Jose Fernandez-Triana of Ottawa, Canada, in recognition of his outstanding efforts to describe and otherwise clarify the taxonomy of the many hundreds of species of microgastrine braconid wasps being reared by the same inventory that discovered this new sawfly.

Food plant and biology. All specimens of *A. josefernandezi* were found as tiny spun cocoons on the leaves of *Hampea appendiculata* (Donn. Sm.) Standl. (Malvaceae). While the cocoons of all other species of sawflies reared by the ACG inventory have been ovoid in shape, the cocoons of *A. josefernandezi* are conspicuously squared off at both ends, making them look like small bricks (Fig. 16). The larvae were not seen, and this may not be the food plant. However, we suspect that it is the food plant because the many cocoons were all on one individual of *H. appendiculata* and not scattered over other individual plants, and were accompanied by large areas of strongly skeletonized leaves. There were two sets, apparently broods, of wild-caught cocoons (2010 and 2011) in the same area on the same species of plant, again suggesting that this really is the food plant.

Remarks. The combination of the following characters will distinguish *A. josefernandezi* from other species of *Atomacera*: tegula, pronotum, and mesonotum (except mesoscutellum) red; mesosternum dark orange; tibiae mostly white with some black at base and apex; interantennal area rounded, without a carina; clypeus, supraclypeal area, and areas surrounding antennae smooth, shiny, without sculpture; very short postocellar area, lacking lateral furrows; and lancet (Fig. 12) with distinct serrulae and short hairs on the annuli. With the red pronotum, tegula, and most of the mesonotum and mostly white tibiae, this species will run to couplet 10, *Atomacera ebena* Smith, in the key to *Atomacera* (Smith 1992). *Atomacera ebena* is separated from *A. josefernandezi* by the presence of a short in-

terantennal carina, the clypeus, supraclypeal area, and interantennal area punctate, the postocellar area defined by lateral furrows, a red mesoscutellum, most of the hind tarsi white, and the lancet with very low serrulae and lacking annular hairs (Fig. 13). This species is also similar to *A. nama* Smith, but *A. nama* has the legs black, metascutellum and metascutellum orange, and flatter serrulae on the lancet (Smith 1992: fig. 113).

Atomacera josefernandezi DNA barcodes (Janzen and Hallwachs 2011) are very distinctively different from all other species of Argidae and Tenthredinidae reared to date in ACG. However, it is noteworthy that the 2010 rearing consistently differed by what appears to be 1 basepair from the 2011 rearing, a very shallow split that needs to be analyzed with a larger sample size. All the specimens found within a year, to date, are likely to be sibs, and therefore in one sense we have DNA barcoded only two specimens (= two broods).

The New World genus *Atomacera* includes about 32 species, 30 of which are Neotropical and were keyed by Smith (1992). It occurs from Canada to Argentina. Only five species apart from the one recorded here have been associated with food plants. *Atomacera pubicornis* (Fabricius) from northern South America feeds on *Ipomoea* sp. (Convolvulaceae) (Smith 1992), *A. petroa* Smith has been reared from *Miconia calvenscens* DC (Melastomataceae) in Costa Rica (Badenes-Perez and Johnson 2007), and *Atomacera raza* (99-SRNP-4547), also reared by the ACG inventory (Smith and Janzen 2003a), was feeding on leaves of *Malvaviscus palmanus* (Malvaceae). The Nearctic species *A. debilis* Say feeds on *Desmodium* sp. (Fabaceae), and *A. decepta* Rohwer feeds on *Hibiscus* sp. (Malvaceae) (Smith 1969).

***Eriglenum tristum* Smith**

http://species-id.net/wiki/Eriglenum_tristum

Figs 16, 18

Eriglenum tristum Smith, 1992: 53.

Remarks. This species was described from a single female from Cartago, Turrialba, Costa Rica. Another species, *E. crudum* Konow, was reared from *Maechaerium acuminatum* Kunth (Fabaceae) in ACG (Smith and Janzen 2003a). *Eriglenum* occurs from Mexico to northern Argentina; see Smith (1992) for separation of the four species.

Distribution. Known only from Costa Rica.

Food plant and biology. Nine specimens from two broods were reared, with voucher codes 03-SRNP-11949, 03-SRNP-11951, 03-SRNP-11952, 03-SRNP-11953, 08-SRNP-70547, 08-SRNP-70548, 08-SRNP-70549 (Fig. 16), 08-SRNP-70550, and 08-SRNP-70551. They were reared from larvae feeding on leaves of *Machaerium seemannii* Benth. Ex Seem. (Fabaceae). The tough, oval cocoon was formed on a leaf (Fig. 18).

***Ptenos leucopodus* (Cameron)**

http://species-id.net/wiki/Ptenos_leucopodus

Sericocera leucopoda Cameron, 1883: 48, pl. 3, fig. 3.

Hemidianeura leucopoda: Smith 1992: 120.

Ptenos leucopodus: Taeger et al. 2010: 169.

Remarks. Specimens in USNM from Venezuela bear a label “caterpillar on Inya sp.” (Smith 1992). This is probably a misspelling for *Inga*. *Ptenos* occurs from southwestern United States and Dominica to Argentina; about 31 species are known, which were keyed by Smith (1992) under the name *Hemidianeura*. Host plants are not known for the other species.

Distribution. Costa Rica, Ecuador, Guyana, Honduras, Mexico (Chiapas, San Luis Potosi, Tabasco, Veracruz), Panama, Surinam, Venezuela (Smith 1992).

Food plant and biology. Nine ACG specimens were reared, with voucher codes 99-SRNP-17561, 99-SRNP-17562, 01-SRNP-22641, 06-SRNP-31799, 06-SRNP-31799.1, 06-SRNP-31799.2, 06-SRNP-31799.3, 06-SRNP-317799.4, and 06-SRNP-31799.5. Larvae were feeding on foliage of *Inga vera* Willd. (ACG dry forest) and *Inga oerstediana* Benth (Fabaceae) (ACG rain forest).

***Ptilia peleterii* (Gray)**

http://species-id.net/wiki/Ptilia_peleterii

Schizocerus Peleterii Gray, 1831 in Gray 1831–1832: 403, pl. 66, fig. 1.

Ptilia peletieri: Smith 1992: 137.

Remarks. This species was reared from *Cnestidium rufescens* Planch. (Connaraceae) in Panama, and the larva was described and biological notes given by Kimsey and Smith (1985). *Ptilia* occurs from Mexico to Brazil; seven species are known (Smith 1992).

Distribution. Brazil (Amazonas, Mato Grosso); Colombia; Costa Rica; Guyana; Panama; Surinam; Trinidad and Tobago (both islands); Venezuela (Smith 1992).

Food plant and biology. One ACG specimen was reared (03-SRNP-20546), feeding on very young foliage of the rain forest woody vine *Cnestidium rufescens*, confirming the report by Kimsey and Smith (1985). A related species, *Ptilia versicolor* (Klug), feeds on *Rourea glabra* Kunth (Connaraceae) in ACG (Smith and Janzen 2003a).

***Scobina lepida* (Klug)**

http://species-id.net/wiki/Scobina_lepida

Fig. 19

Hylotoma lepida Klug, 1834: 239.

Scobina lepida: Smith 1992: 26.

Remarks. This is one of the more common species of *Scobina* in Central America, but the host plant was not known. *Scobina* includes about 50 species from Mexico to Argentina, and they were keyed by Smith (1992). Host information was known for only three species, *S. guatemalensis* (Dalla Torre), *S. consobrina* (Norton), and *S. notaticollis* (Konow), all of which fed on the foliage of *Sida* (Malvaceae).

Distribution. Costa Rica, El Salvador, Guatemala, Honduras, Mexico (Chiapas, Oaxaca, Veracruz), Nicaragua, Panama (Smith 1992).

Food plant and biology. One larva (07-SRNP-40019) was found eating mature leaves of rain forest *Sida rhombifolia* L. (Malvaceae), a common pasture and roadside woody herb. The fibrous, oval cocoon was on a leaf (Fig. 19).

Scobina notaticollis (Konow)

http://species-id.net/wiki/Scobina_notaticollis

Fig. 20

Labidarge notaticollis Konow, 1899: 310.

Scobina notaticollis: Smith 1992: 29.

Remarks. Costa Rica is the northernmost record for this species.

Distribution. Bolivia; Colombia, Costa Rica, Ecuador, Panama, Peru, Venezuela (Smith 1992).

Food plant and biology. One larva (Fig. 20) was found feeding on foliage of ACG rain forest *Sida rhombifolia* (06-SRNP-44107) .

Tenthredinidae

Dochmioglene crassa (Cameron), comb. n.

http://species-id.net/wiki/Dochmioglene_crassa

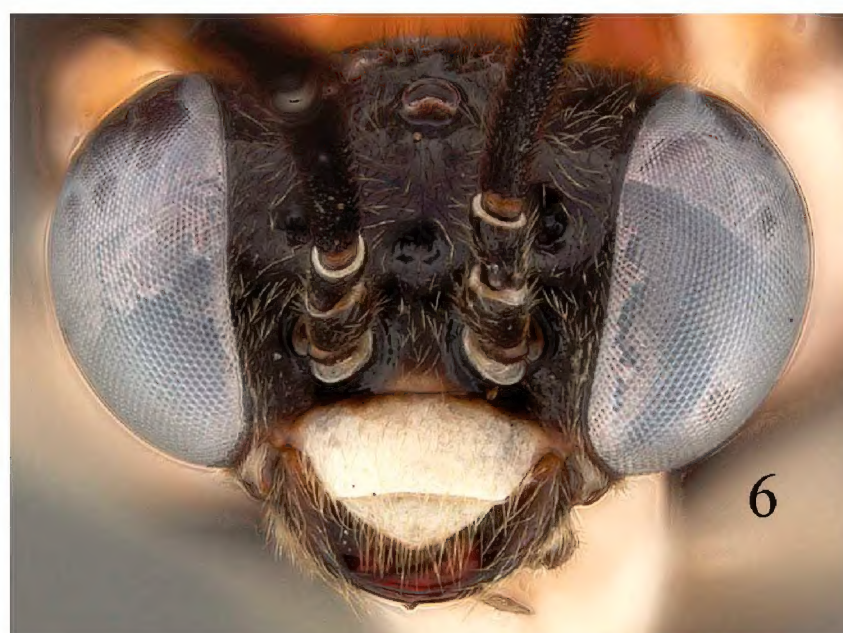
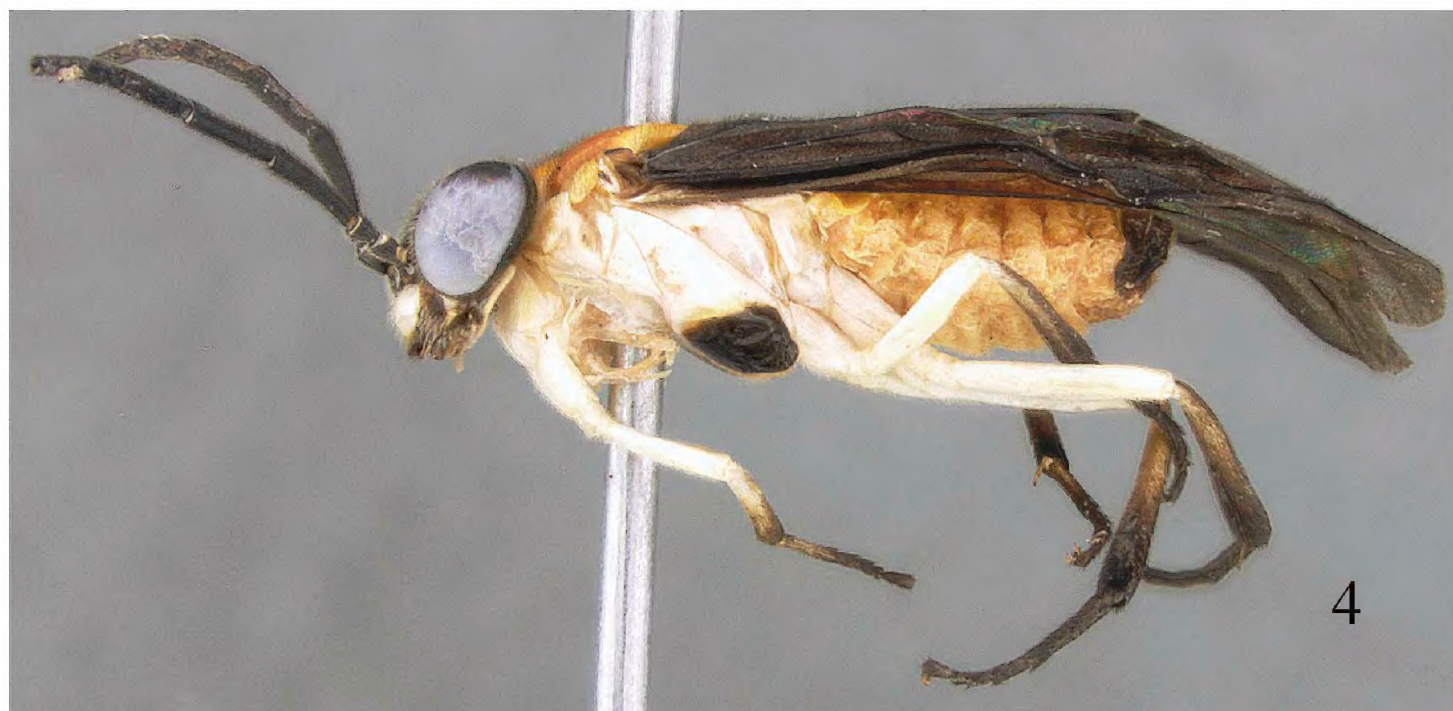
Figs 4–6

Selandria crassa Cameron, 1883: 19, pl. 1, fig. 5.

Remarks. *Dochmioglene* includes about 11 species distributed from Central America to Argentina (Smith, unpublished). The genus has not been revised. The reared specimen (Figs 4–6) agrees with *D. crassa* except for the lack of a black mark on the mesoprescutum. This mark, however, is faint to absent in some other specimens examined.

Dochmioglene belongs in the subfamily Selandriinae, which includes many species associated with ferns. This rearing, and that of the following species, confirms that larvae of many Neotropical selandriine species may be feeding on fern foliage.

Cameron (1883) described the female from “Guatemala, San Isidro 1600 feet” and mentioned that a male from El Tumbador may be the male of the species. Because



Figures 4–6. *Dochmioglene crassa*. **4** Lateral **5** Dorsum of head and thorax **6** Face, front.

Cameron did not designate a holotype, apparently included a male, and did not state how many specimens were available, a lectotype is here designated. The female of *Selandria crassa* in BMNH, labeled "Type H.T.," "B.M. type :Hym. 1.266," "B.C.A. Hymen. I, Selandria crassa Cam.," "San Isidro, 1600 ft., Champion" and "Selandria crassa Cam., type, BCA Hy 1, 10" is designated the lectotype. The combination in *Dochmioglène* has not been published and is based on study of the type by DRS.

Distribution. Costa Rica, Guatemala, Panama, Surinam (Smith, unpublished).

Food plant and biology. One specimen, 09-SRNP-32388, was found feeding on the foliage of an ACG rain forest fern, *Lomariopsis vestita* E. Fourn. (Lomariopsidaceae).

Dochmioglène Smith03

Remarks. Only parts of the reared adult are stored in a gelatin capsule. They are sufficient to place it in *Dochmioglène*, but there is not enough left to tell if this is the same as *D. crassa* or another species. Since the host plant is different than that of *D. crassa* and we cannot be sure it is the same, we here consider it as a second reared species of the genus in ACG, with the interim name of *Dochmioglène* Smith03.

Distribution. Known only from the single specimen from ACG.

Food plant and biology. One specimen, 09-SRNP-21528, was found feeding on the foliage of a rain forest fern, *Blechnum occidentale* L. (Blechnaceae).

Waldheimia laeta (Cameron)

http://species-id.net/wiki/Waldheimia_laeta

Monophadnus laetus Cameron, 1883: 22.

Remarks. *Waldheimia* is a large genus of nearly 100 species and occurs from southwestern United States to Argentina. *Waldheimia laeta* is separated by its black head, wings yellow with apices black, abdomen orange with apex black, and the very short, triangular lancet with indiscernible serrulae.

The host plants of five species of *Waldheimia* in Costa Rica are now known: *W. laeta* and *W. lucianocapellii* are treated here. *Waldheimia suturalis* (Cameron) feeds on very young leaves of *Cissus rhombifolia* Vahl, *W. fascipennis* (Norton) feeds on very young leaves of *Cissus pseudosicyoides* Croat (Vitaceae), and *W. interstitialis* (Cameron) feeds on leaves of *Hamelia patens* Jacq. (Rubiaceae) (Smith and Janzen 2003b).

Distribution. Bolivia, Colombia, Costa Rica, Panama, Peru, Trinidad, Venezuela (Smith, unpublished)

Food plant and biology. One specimen, 09-SRNP-6456, found feeding on very young leaves of ACG dry forest *Cissus alata* Jacq. (Vitaceae), the same host genus as *W. suturalis* and *W. fascipennis* (Smith and Janzen 2003b). This sawfly did not spin a cocoon, but rather pupated naked in the leaf litter.

***Waldheimia lucianocapellii* Smith, sp. n.**

<http://zoobank.org/D281ED64-E3C0-4F27-A155-F24009AA67A5>

http://species-id.net/wiki/Waldheimia_lucianocapellii

Figs 7–11, 14, 21, 22

Description. Female (Figs 7–9). Length, 7.0 mm. Antenna black with antennomeres 1 and 2 and basal 2/3 of 3rd yellow. Head yellow with area just in front of anterior ocellus to posterior margin of head and hind orbits above eyes black; apex of mandible reddish. Thorax yellow with triangular black spot on mesoprescutum. Abdomen yellow with apical segments and sheath black. Legs yellow, apex of foretarsus and apex of midtarsus infuscated; apical 2/3 of hind tibia, apical 2/3 of hind basitarsomere, and apical 4 hind tarsomeres black. Wings fasciated, area apical to apex of stigma and area basal to intercostal veins darkly infuscated, center yellow; extreme base of costa yellow; stigma yellow; veins in yellow area, yellow; veins in infuscated area, black.

Antenna 2.0× head width, apical 4 segments longer than broad and shorter than segments 4 and 5 combined. Lower interocular distance 0.8× eye length; distances between eye and hind ocellus, between hind ocelli, and between hind ocellus and posterior margin of head as 1.0:1.0:1.0. Malar space absent. Hind basitarsomere longer than following tarsomeres combined. Sheath rounded at apex in lateral view. Lancet (Fig. 14) with serrulae flat, each with 7–9 fine subbasal teeth; annular hairs dense, short.

Male. Length, 7.0 mm. Similar in color to female. Male genitalia in Figs 10, 11; harpe tapering to rounded apex; parapenis rounded on inner margin, almost straight on outer margin; valviceps of penis valve with long, rounded dorsal lobe.

Type material. Holotype female labeled, “Barro Colorado, CZ, Pan., R.C. Shannon, VII-19-23” (USNM). Paratypes: Panama, Canal Zone, Barro Colorado Is., 9°9'N, 79°51'W, 8–15 Feb. 1995, J. Pickering (1 ♀); same data except 3 May, 1995 (1 ♀), 19–26 Jan. 1994 (1 ♀); Panama, Canal Zone, Barrow Colorado Is., 9 May 1978, in Malaise trap, 20 m up in Tachigaua, Rainer Krell (1 ♂) (USNM).

Other specimen. Costa Rica, Area de Conservación Guanacaste, lat11.01926 long -85.40997, 14 Oct 2005, 05-SRNP-33935 (1 ♀, USNM) (<http://Janzen.sas.upenn.edu>).

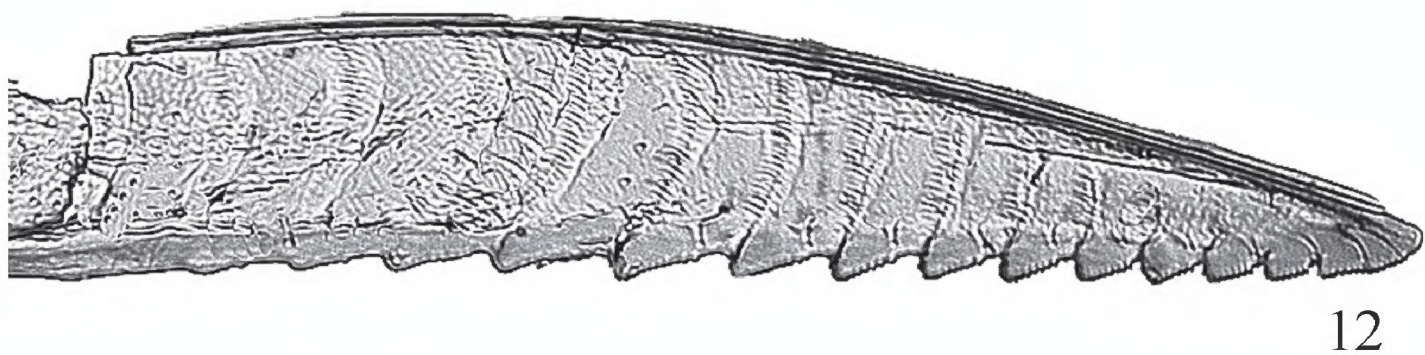
Etymology. This species is named in honor of Luciano Capelli of San Jose, Costa Rica, for his intense and generous efforts to publicize ACG conservation with outstanding video and photographs for the Costa Rican and international public.

Food plant and biology. One specimen, 05-SRNP-33935, was reared from *Davilla nitida* (Vahl) Kubitzki (Dilleniaceae). The larva (Figs 21, 22) is very similar to that of *W. interstitialis*, illustrated by Smith and Janzen (2003b: fig.3).

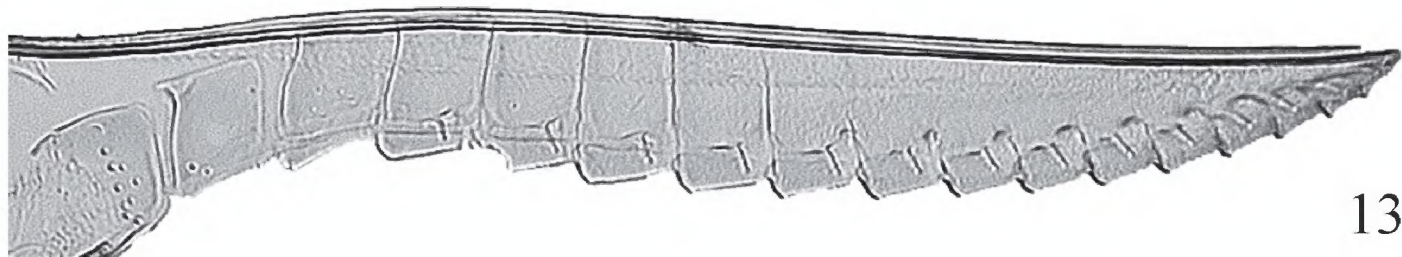
Remarks. The specimen reared from Costa Rica is not complete and is not included in the type series. However, enough is present, including the lancet, to show it



Figures 7–11. *Waldheimia lucianocapellii*. **7** Lateral **8** Dorsal **9** Face, front **10** Male genital capsule, ventral **11** Male penis valve, lateral.



12



13



14



15

Figures 12–15. Lancets. **12** *Atomacera josefernandezi* **13** *A. ebena* **14** *Waldheimia lucianocapellii* **15** *W. fascipennis*.

is the same as the specimens from Panama. It DNA barcodes as far from the other 4 species of *Waldheimia* that were DNA barcoded, as they do from each other.

This species is similar to *Waldheimia duckei* Konow of South America, but *W. lucianocapellii* is separated by the mostly black mesoprescutum, white base of the hind tibia and base of the hind basitarsomere, yellow antennomeres 1 and 2 and base of 3rd, head pale from above antennae to clypeus, and low flat serrulae of the lancet (Fig. 14). The only other species with which it might be confused in Costa Rica is *W. fascipennis*, which also has the wings broadly black at the base and apex and yellow at the center; however, *W. fascipennis* has an entirely orange head, entirely white hind basitarsomere, and deeper serrulae on the lancet (Fig. 15).



Figures 16–22. 16 Adult of *Eriglenum tristum* 17 Cocoon of *Atomacera josefernandezi* on leaf 18 Cocoon of *Eriglenum tristum* on leaf 19 cocoon of *Scobina lepida* 20 Larva of *Scobina notaticollis* 21, 22 Larvae of *Waldheimia lucianocapellii*.

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References

- Badenes-Perez FR, Johnson MT (2007) Ecology, host specificity and impact of *Atomacera petroa* Smith (Hymenoptera: Argidae) on *Miconia calvescens* DC (Melastomataceae). *Biological Control* 43: 95–101. doi: 10.1016/j.biocontrol.2007.05.011
- Burns JM, Janzen DH (2001) Biodiversity of pyrrhopygine skipper butterflies (Hesperiidae) in the Area de Conservación Guanacaste, Costa Rica. *Journal of the Lepidopterists' Society* 55: 15–43.
- Cameron P (1883) Hymenoptera, Tenthredinidae – Chrysididae. In: Godman D, Salvin G. *Biologia Centrali-Americana*, Vol. 1, 486 pp.
- Gray GR (1831–1832) [New species of insects of all orders]. In: Griffith E, Pidgeon E, Gray GR. *The Class Insecta, Arranged by the Baron Cuvier, with Supplementary Additions to each Order*, Vol. 14, 1–570 [1831]; Vol. 15, 1–796 [1832]. G. B. Whittaker, London.
- Janzen DH (2000) Costa Rica's Area de Conservación Guanacaste: A long march to survival through non-damaging biodevelopment. *Biodiversity* 1: 7–20. doi: 10.1080/14888386.2000.9712501
- Janzen DH (2001) Ecology of dry forest woodland insects in the Area de Conservación Guanacaste, northwestern Costa Rica. In: Frankie G, Mata WA, Vinson SB (Eds) *Biodiversity Conservation in Costa Rica: Learning the Lessons in Seasonal Dry Forest*. University of California Press, Berkeley, 1–44.
- Janzen DH, Hallwachs W (2011) Joining inventory by parataxonomists with DNA barcoding of a large complex tropical conserved wildland in northwestern Costa Rica. *PLoS ONE* 6(8): e18123. doi: 10.1371/journal.pone.0018123
- Janzen DH, Hallwachs W, Blandin P, Burns JM, Cadiou J, Chacon I, Dapkey T, Deans AR, Epstein ME, Espinoza B, Franclemont JG, Haber WA, Hajibabaei M, Hall JPW, Hebert PDN, Gauld ID, Harvey DJ, Hausmann A, Kitching I, Lafontaine D, Landry J, Lemaire C, Miller JY, Miller JS, Miller L, Miller SE, Montero J, Munroe E, Rab Green S, Ratnasingham S, Rawlins JE, Robbins RK, Rodriguez JJ, Rougerie R, Sharkey MJ, Smith MA, Solis MA, Sullivan JB, Thiaucourt P, Wahl DB, Weller SJ, Whitfield JB, Willmott KR, Wood DM, Woodley NE, Wilson JJ (2009) Integration of DNA barcoding into an ongoing inventory of complex tropical biodiversity. *Molecular Ecology Resources* 9 (Supplement 1): 1–26. doi: 10.1111/j.1755-0998.2009.02628.x
- Kimsey LS, Smith DR (1985) Two new species, larval descriptions and life history notes on some Panamanian sawflies (Hymenoptera: Argidae, Tenthredinidae). *Proceedings of the Entomological Society of Washington* 87: 191–201.

- Klug JCF (1834) Uebersicht der Tenthredinetae der Sammlung (des Berliner entomologischen Museums). Jahrbucher Insektenkunde 1: 233–253.
- Konow F (1899) Neue Tenthredinidae aus Südamerika. Entomologische Nachrichten 25: 307–316.
- Smith DR (1969) Key to genera of Nearctic Argidae (Hymenoptera) with revisions of the genera *Atomacera* Say and *Sterictiphora* Billberg. Transactions of the American Entomological Society 95: 439–457.
- Smith DR (1992) A synopsis of the sawflies (Hymenoptera: Symphyta) of America south of the United States: Argidae. Memoirs of the American Entomological Society, Number 39, 201 pp.
- Smith DR, Janzen DH (2003a) Food plants and life histories of sawflies of the family Argidae (Hymenoptera) in Costa Rica, with descriptions of two new species. Journal of Hymenoptera Research 12: 193–208.
- Smith DR, Janzen DH (2003b) Food plants and life histories of sawflies of the families Tenthredinidae and Pergidae (Hymenoptera) in Costa Rica, with descriptions of four new species. Journal of Hymenoptera Research 12: 312–332.
- Taeger A, Blank SM, Liston AD (2010) World catalog of Symphyta (Hymenoptera). Zootaxa 2580: 1–1064.